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for Intellectual Property
and Acting Director of the U.S.
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PROVISIONAL APPLICATION FOR PATENT COVER SHEET

Mail Stop Provisional Patent Application
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53(c).

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TITLE OF INVENTION (280 characters max)

ACCESSIBLE TESTING SYSTEM (ATS)

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ENCLOSED APPLICATION PARTS (check all that apply)

[X] Specification   Number of Pages [44]   [X] Applicant claims small entity status.

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[X] A check or money order is enclosed to cover the filing fees.   [$80] FILING FEE AMOUNT

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The invention was made by an agency of the United States Government or under a contract with an Agency of the United States Government.

[x] No.

[ ] Yes, the name of the U.S. government agency and the Government contract number are _____

Respectfully submitted,

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[ ] Additional inventors are being named on separately numbered sheets attached hereto.

USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT

PROVISIONAL PATENT APPLICATION
Our Case No. 7450/14

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
APPLICATION FOR UNITED STATES LETTERS PATENT

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This application claims the priority of U.S. Non-Provisional Application No. 10/702,166 filed November 5, 2003 that claims the priority of U.S. Provisional Application No. 60/423,930 filed November 5, 2002

Accessible Testing System (ATS)

Provisional Patent Application

Defining an Accessible Testing System (ATS)

There are three major motivations to the development of an Accessible Testing System: broader impact, increased cost effectiveness, and portability. Each of these reasons for development will be discussed in turn below.

The core gh technology behind the ATS integrates many different types of accessible media: Braille, Large Print, Audio, Foreign Language, and more. The ATS lets a broad range of people gain access to information from tests and review materials. This results in one accessible test that can be used for everyone. The ATS provides true just-in-time accessibility to students having a variety of special needs.

Broader Impact

With ATS, now everyone has access to tests and review materials. The core gh ATS technology supports several types of accessible media for a broad range of people to take tests. This all-in-one testing source proves to be useful for people with disabilities as well as those who are non-disabled, making the technology also useful as a mainstream application. Whether the student needs electronic Braille or an Audio version, just select the appropriate interface, open the test from the removable media device and start the test. ATS truly makes testing that easy.

Who ATS Impacts

The ATS, with all of its accessible media, impacts you, me, and everyone in between. Whether it's students with disabilities, individuals who speak other languages or even people without any disabilities who just want to take a test, this is a cost-effective solution that impacts a broad base of people.

The following categories of test-takers can benefit from the ATS testing environment:

Disability Category helped by ATS
Blindness
Low-Vision
Learning & Cognitive Disabilities
Mobility Impairments
Deaf & Hard of Hearing
Augmentative and Alternative Communication
Mainstream Category helped by ATS
General Mainstream
English as a Second Language
Foreign Language
Basic Literacy

Each category will be discussed in more detail below.

Blindness

The Challenge of Blindness

People who are blind face challenges seeing the computer monitor, reading printed material, and understanding pictures and graphs. They must rely upon non-visual methods by using audio and tactile formats.

The Blindness Solution

The ATS benefits people who are blind by incorporating self-voicing interfaces, speech output using Text-to-Speech (TTS), customized keyboard control, and compatibility with both a Braille display and Braille embosser just to name a few.

Low Vision

The Challenge of Low Vision

People with low vision face similar challenges of seeing the computer monitor, reading printed material, and understanding pictures and graphs. They may also rely upon non-visual methods by using audio and tactile formats, or they can adjust the computer display to improve the contrast and size of the information.

The Low Vision Solution

The ATS benefits people with low vision by incorporating display contrast control to adjust the background/foreground color, CCTV-like screen enlargement capabilities, text highlighting, and a page preview pane for absolute and relative positioning.

Learning & Cognitive Disabilities

The Challenge of Learning & Cognitive Disabilities

People with learning and cognitive disabilities may have visual processing problems, motor problems, or problems processing oral instructions. gh primarily focuses on helping people who have reading and visual processing problems when accessing information contained in print and electronic media. The predominant limitations include problems with spelling, finding their place on the computer screen and comprehending the logical order of the text.

The Learning & Cognitive Disabilities Solution

The ATS benefits people with learning disabilities by incorporating text highlighting for reading comprehension, adjustable reading rate control, spelling and

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dictionary features for unfamiliar words, format control to cue reader about document styles, synchronized media streams for multimodal stimulus, and a 'Repeat' function.

Mobility Impairments

The Challenge of Mobility Impairments

People with mobility impairments include people with congenital disabilities, spinal cord injuries, progressive neuralgic disease, and people who are without the use of hands, arms, or legs. gh primarily focuses on helping people who have difficulties using their hands where the predominant limitation is the inability to use a standard keyboard for typing, navigating electronic media, and writing down information.

The Mobility Impairments Solution

The ATS benefits people with a mobility impairment by supporting alternative pointing devices, including voice recognition capability, user-definable keyboards, and on-screen virtual keyboards and word prediction.

Deaf & Hard of Hearing

The Challenge of Deaf & Hard of Hearing

People who are deaf or hard of hearing range from those who have a slight hearing loss to deafness. People who are hard of hearing may be able to hear some sound, but may find it difficult to comprehend words. Similarly, people who are deaf are not able to hear any sound and must rely on alternative forms of communication.

The Deaf & Hard of Hearing Solution

The ATS benefits people with hearing impairments by providing Virtual Sign Language (vSL) that translates text and audio into American Sign Language (ASL). vSL can take the form of either a virtual reality avatar or human concatenated video. Text captioning is also provided in synchronization with the vSL.

Augmentative and Alternative Communication

The Challenge of Augmentative and Alternative Communication

People who are dependant on alternative forms of communication may have poor or developing spelling and reading skills. This may make the task of taking notes difficult while reading comprehension may be affected as well.

The Augmentative and Alternative Communication Solution

The ATS benefits people who use alternative forms of communication by offering reading and writing tools. For example, users may choose to have a word verbally spelled or one can look up the definition of an unfamiliar word. When taking notes, users have the added advantage of word prediction features to accelerate the process of note taking, as well as the assistance of a thesaurus.

General Mainstream

The Challenge of the General Mainstream

People inherently have different methods for reading and learning. In fact, the general population maintains diverse reading and learning styles that range from those who require multimodal communication techniques, such as speech combined with text and images, to people on the go who require portability and convenience. Moreover, some people enjoy taking notes in a separate notebook while others prefer to scribble in the margins of the test. People just need options.

The General Mainstream Solution

The ATS benefits the general population by catering to those who prefer the benefits of an electronic test over a hard copy. The ATS offers a variety of reading and learning techniques by incorporating synchronized multimedia including text highlighting, pictures, and speech to sign language and captioning. The mere digital format benefits those who prefer to read electronic books over cumbersome hard copies. Similarly, it offers convenient storage and portability for those people looking to minimize space and transport with ease.

English as a Second Language

The Challenge of English as a Second Language

People who want to learn English as a second language may have poor reading and listening comprehension skills, minimal speaking and pronunciation proficiency, as well as a limited vocabulary base. The combination of these deficiencies makes it difficult to improve English language skills unless they have the opportunity to practice them.

The English as a Second Language Solution

The ATS benefits people who want to learn English by offering ESL-mode features for tests that provide people with the opportunity to practice their English language skills. For example, images of words and phrases are displayed in concert with the text, and users can listen to the pronunciation of a word in English or even listen to the foreign language-equivalent while reading the English text. Furthermore, users can

look up the definition of unfamiliar words with a dictionary and toggle between foreign languages.

Foreign Language

The Challenge of Foreign Language

People who only speak a foreign language most often have poor English literacy skills and must rely heavily on translated reading material. On a different note, English-speaking students in foreign language environments may require translated tests.

The Foreign Language Solution

The ATS benefits people who need translated tests in foreign languages. Users can toggle between the foreign language and print and even use a dictionary to clarify the definition of the foreign word. Multiple languages ranging from Spanish to Japanese can be included for users toggle between.

Basic Literacy

The Challenge of Basic Literacy

The recognition and understanding that spoken words are made up of speech sounds, or phonemic awareness, is central to one's reading ability. People with basic literacy skills need tools to help them learn the fundamentals of reading.

The Basic Literacy Solution

The ATS helps people improve literacy skills by synchronizing text with the speech output so users can listen to the pronunciation of the word while viewing it in the text. In the event that users need special assistance with a word, they can choose to have a word phonetically "sounded out" or spelled letter-by-letter. A thesaurus and dictionary are also made available to users.

Increased Cost Effectiveness

The second important feature of the ATS is that it saves money. This means that you only have to buy one test for everybody, instead of several different media types such as print, Braille, Audio, and Large Print. And since it's all stored on one removable media device and you just use the ATS unit to access it, there's no need to buy six different types of books. Moreover, the electronic file format eliminates the cost of printing, warehousing, shipping, and distribution and further reduces the expense.

Portability

The third important feature of the ATS is Portability. The electronic media file format combined with the ATS unit itself defines portability. When you want to take the unit to class or work late at home, you can. There's no heavy TV monitor or cumbersome stacks of books to carry. It's just an ATS and it's just-in-time accessibility.

Description of Core Services

The following core products and services are offered as part of this quotation:

ATS "hard" technology

Hard technology is defined as the actual software and hardware that in combination provides the necessary intervention for the special needs student. In this case, the Accessible Testing station is composed of a core hardware unit which has been pre-loaded with custom software designed specifically for the self-voicing GRE pilot test. Each is described in more detail below.

Employing both hardware and software together for the ATS has the following advantages:

- No need to develop software to handle a variety of systems already in the field, as the system specifications are set
- Much less chance of device failure due to software integration problems
- More cost-effective since the device contains only the parts and capacities that are needed, and nothing extra
- Logistics are much easier for shipping and repair since there is only one type of device, case, and shipping carton
- Sufficient hardware power can be guaranteed to run all of the desired software features (which may be quite processor-intensive)
- Complete security can be achieved by using a custom OS designed for the testing environment

A total of 10 (ten) ATS units will be produced by gh during the pilot study. The distribution of these units will be broken down as shown in the following table:

# units	Location
2	In-house development stations for gh
1	On-site ETS unit (Princeton office)
2	Blind student test stations
2	Low-vision student test stations
1	Mobility Impaired student test station

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.1	Learning Disabled student test station
1	Spanish-speaking student test station
10	TOTAL ATS UNITS FOR PILOT

ATS Hardware Platform

The core ATS hardware platform is a minicomputer capable of running Windows XP (Embedded) Operating system. The device has sufficient input and output capabilities to allow for a variety of students with varying needs to use the system. The system also includes removable media for test storage. Each is described in more detail below. In addition, a list of default input and output devices is given.

ATS core Unit

The ATS core unit is a portable Windows XP computer which has been custom-modified for the task of delivering electronic tests in a secure and accessible manner. The specifications for the core unit (illustrated below) are as follows:
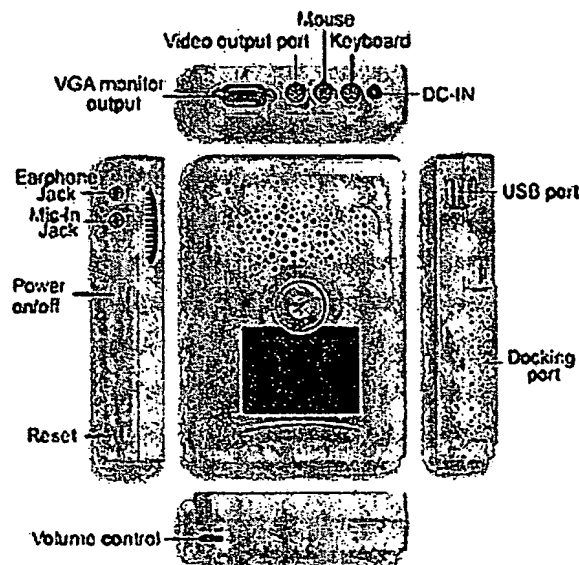

Figure 1: the core ATS unit in standard configuration

- Processor: VIA C3 processor (900MHz).
- Memory: 256MB with one 144-pin SODIMM module
- Video: Intel 810, Video Memory 11MB (shared Memory) .Supports up to 1280 by 1024-pixel resolution (native resolution of the software is 800 x 600).
- Audio: Built-in 16-bit stereo (sound blaster / Adlib compatible) with a built-in speaker.
- Hard Drive: One 2.5" (8.5mm thickness) Ultra DMA 33/66 hard drive (20 GB).

- I/O Ports: Two USB ports, VGA port, one 3.5mm Micro-phone in port, one 3.5 mm line out port (using Active Speaker), one S-Video and AV video port, one 6 pin PS/2 mouse port, one 6 pin PS/2 keyboard port, and one connector for docking station.
- Weight & Size: System approximately 460g (1 lb). System Dimension: 150mm x 106mm x 32mm (6"x4"x1.25")
- Docking Station (optional): One ATAPI interface slim 24x CD-ROM, one 3.5" 1.44MB Floppy Disk Drive, one 9 pin serial port (RS-232), one 25 pin Parallel port (EPP / ECP), and two USB ports.
- Power: AC power adapter, optional battery power (est. 2-3 hour battery life).

The case for the ATS will be custom-modified as well so that the user can use the ATS without needing an external keyboard (as shown in the below illustration). Sufficient buttons for navigation and user input (e. g. buttons answer choices a, b, c, d, and e) will be incorporated into the ATS model. The size and weight of the custom-modified case will not change significantly from the above standard configuration.
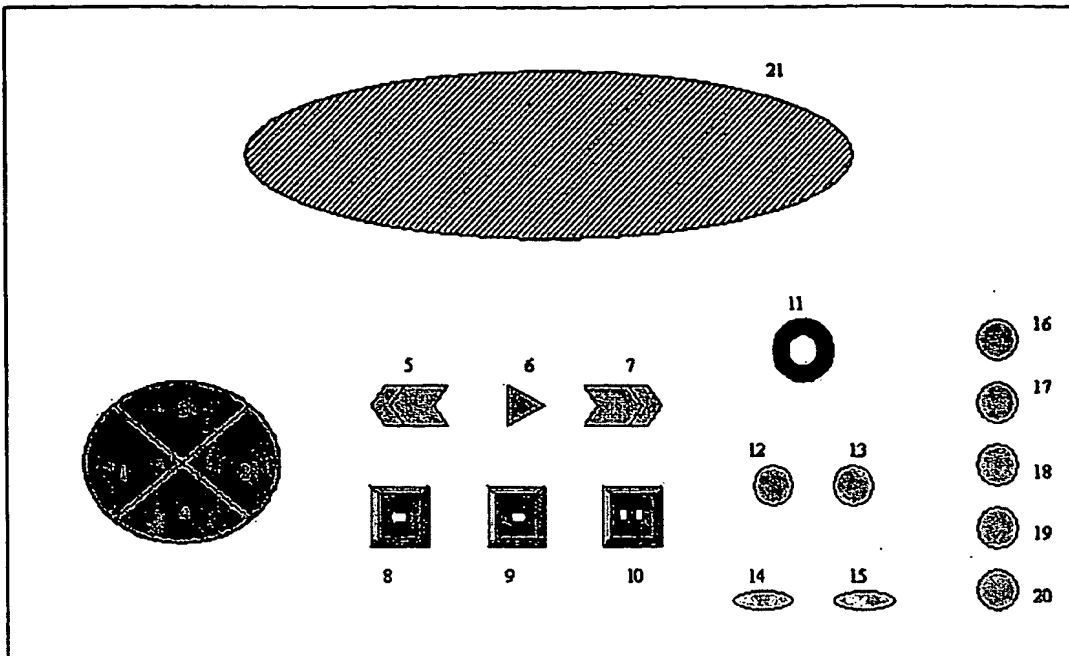
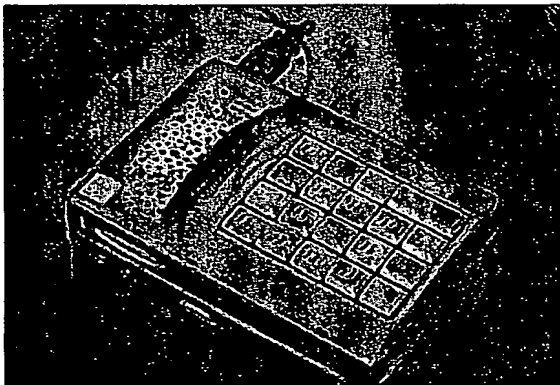Figure 2: Proposed Key Layout for the ATS Hardware Unit (Top View)

Figure 3: Sample ATS hardware prototype #1

Figure 4: Sample ATS hardware prototype #2

The user-input keys illustrated in the modified ATS unit would be mapped as follows:

Key	Function
1	Jump To Previous Section
2	Jump to Next Section
3	Page Up
4	Page Down
5	Previous Question
6	Play Audio
7	Next Question
8	Advance Audio Back 5 Seconds (optional)
9	Advance Audio Forward 5 Seconds (optional)
10	Pause Audio
11	Toggle Self-Voicing Keys ON/OFF
12	Open Help File
13	Return to Beginning of Test
14	Decrease Reading Rate
15	Increase Reading Rate
16	Answer Choice "A"
17	Answer Choice "B"
18	Answer Choice "C"
19	Answer Choice "D"
20	Answer Choice "E"
21	Speaker Grille

The ATS Unit would also come with a carrying case sufficient to hold the needed accessories (such as an AC Power adapter or extra batteries). A sample carrying case is shown below:
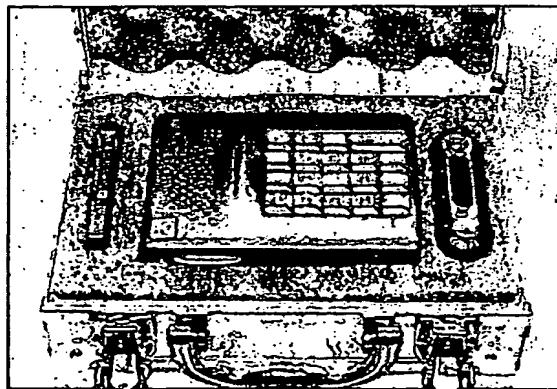

Figure 5: Carrying Case for ATS Unit (including sample prototype)

ATS Removable Media for Test Storage

The ATS removable media used for storing the test will be a USB-based product (pictured below). This drive not only stores data, but also plays MP3 audio files and also records voice notes (DVR-Digital Voice Recorder). With its compact design, it offers both high-quality sound as an MP3 player and versatility as a data storage device. The DVR function lets the student take notes and play them back instantly with high-quality digital sound. The device requires no cables for independent usage other than headphones/earphones.
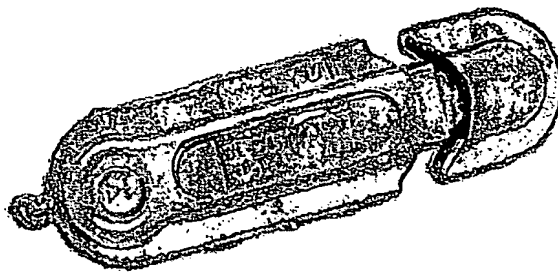

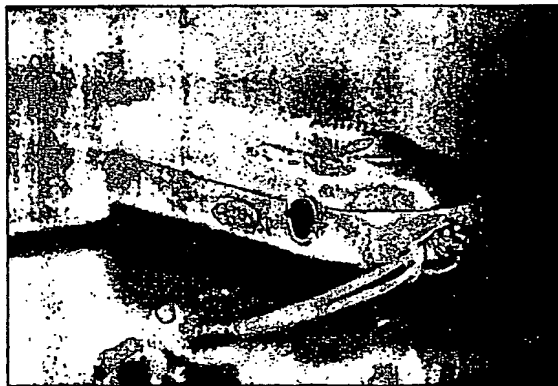**Figure 6: Removable Media Storage Device (includes MP3 Player)**

Figure 7: Close-up of Removable Media Storage Device (includes MP3 Player)

The drive is small enough to fit in a shirt pocket, key chain or briefcase. Students and proctors can both easily access the skip-free MP3 and DVR features. The standard configuration holds up to 180 minutes of MP3 music and up to 512 minutes of voice recording, although more than double this storage will be available for the ATS configuration. Since the actual tests themselves will be XML files (and speech will be generated on the fly by the ATS unit), there will be more than enough storage space to include both the fully accessible READ version of the test and a pre-recorded audio version in MP3 format. The student will have the ability to record about 1 hour's worth of audio notes which, like the test itself, will be collected on the stick along with the test by the proctor and returned to ETS (just like scratch-paper notes would be for the print test).

The product has the following specifications:

- Removable USB Drive for general file storage – Windows file system compatible (NTFS or FAT32)
- MP3 and WMA Playback
- Digital Voice Recording
- 5-ModeEqualizer (Jazz/Classic/Rock/POP and Normal)
- Back-Light LCD display
- Dynamic Bass Booster
- High Speed USB connection (7Mbps)
- ID 3 TAG Display Support
- Includes in-ear headphones
- Includes Repeat A-B and Repeat Mode
- Capacity: up to 256 MB (standard configuration is 128 MB)
- MP3 at 32Kbps (sufficient for recorded speech): 512 minutes (1024 minutes if the speech is recorded in monaural mode)
- ADPCM voice recording: 512 minutes (monaural)
- Battery Life: 12 Hours (recharges from USB port)
- Interface: USB 2.0 (supports USB 1.1)
- Transfer Speed: 12MBits/sec
- Power: 1 AAA Battery
- Audio Frequency Range: 20Hz-20KHz
- Audio Signal/noise: 85dB ~ 90Db
- Audio Total Distortion: 0.08%
- Physical Characteristics: Height: 12mm, Width: 17mm, Depth: 113mm, Weight: 50gm (w/battery)

ATS Input Devices

The ATS devices will have two main options for user input: devices that are shipped with the product, and devices that the student already owns and chooses to use. The following input devices will ship with the ATS unit:

Portable Keyboard

The ATS unit will ship with a portable, pocket-sized roll-up keyboard (pictured below). The 72-key layout offers portability and function without compromising usability. The keys are full-size so the student won't have to change typing styles when switching between a PC and the ATS station. The keyboard can be used for data entry for essay questions and other typing/editing situations, and can also be used for navigation and playback (in lieu of the buttons on the unit itself).
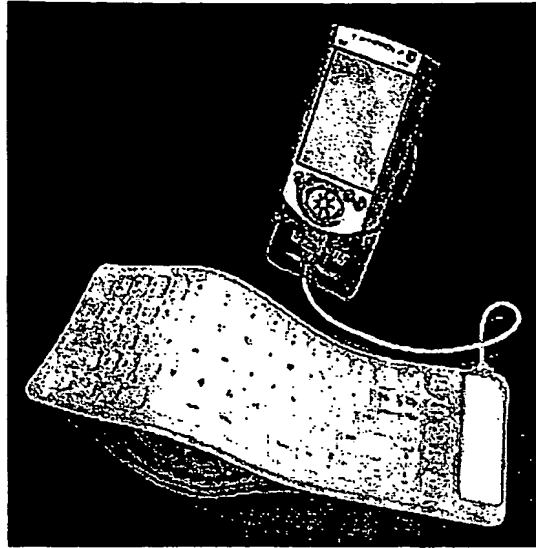
Figure 8: An example of a portable keyboard for ATS unit (shown to scale next to PDA handheld device)

A key layout for the portable keyboard is shown below as well.
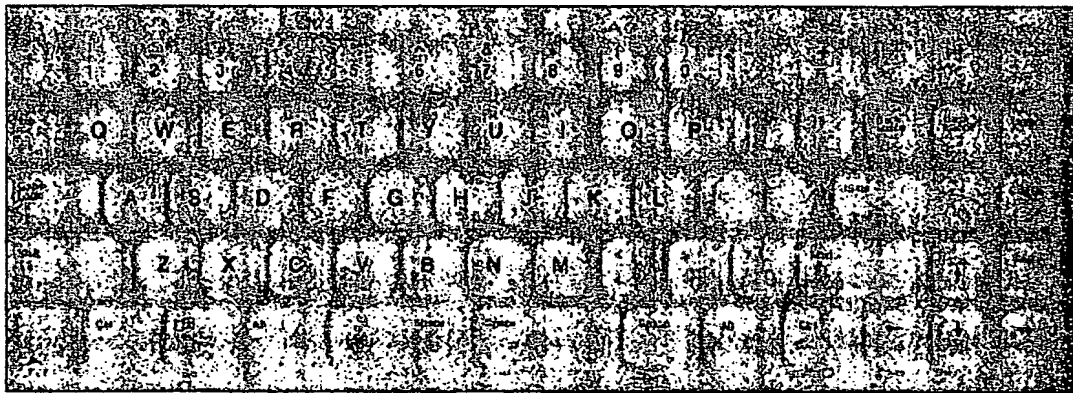

Figure 9: An example key layout for the ATS portable keyboard

The device specifications for the portable keyboard are as follows:

- Compatibility: USB (PS/2 optional)
- Key layout: 72 keys (109 keys optional)
- Special Keys: Windows Hotkeys (Start Menu and Application Control Menu); Windows Power Management Hotkeys
- Rolls up to fit in a typical shirt pocket
- Washable and durable; can sustain liquid spills and drops

Note that the USB version of the keyboard will be used, so that the ATS PS/2 port remains free for a user-selected keyboard. Users can also daisy-chain other USB keyboards and use either keyboard for data entry.

Portable Mouse

The ATS unit will ship with a portable, pocket-sized optical mouse (pictured below). Over 50% smaller than a standard mouse (2 by 3.5 inches), the ATS portable mouse has a conventional teardrop or egg shape and a very long (five-foot) cord with USB connector. The longer cord makes the mouse usable with desktop as well as laptop PCs if the student wants to replace an old mechanical mouse on their desktop computer for purposes of practicing with the portable mouse. A PS/2 adapter plug can also be provided with the ATS station in case the student lacks a USB port on their desktop computer.
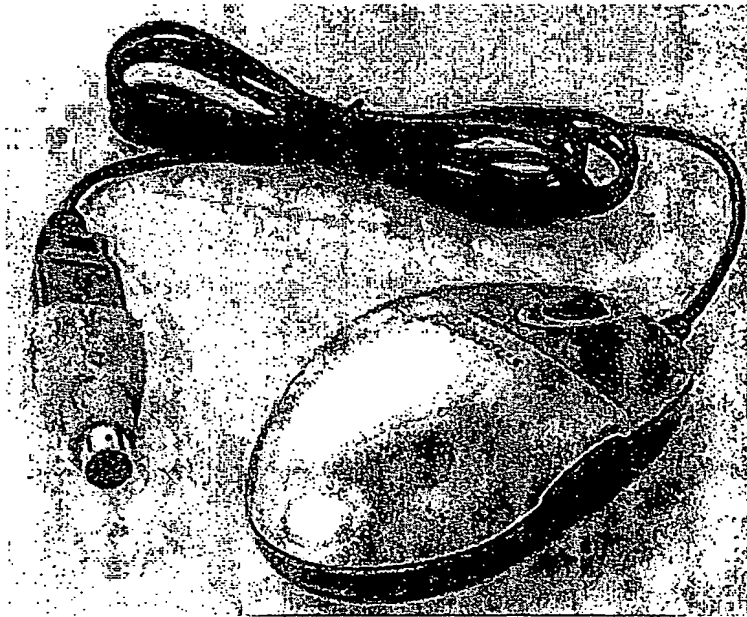

Figure 10: An example portable Mouse for ATS unit (includes PS/2 adapter)

Thanks to optical design, the mouse moves smoothly and work well, can be used on almost any surface (including a pant leg or other non-horizontal surface), and does not require a mouse pad to operate. The slightly long, tapered portable mouse is a comfortable for the student to rest their hand for long periods in a typical test environment (i. e. desk and chair). The portable mouse buttons and scroll wheel are small and stiff with good tactile and auditory feedback when clicked.

The proposed ATS portable mouse is the first downsized mouse with five rather than three buttons -- a small button on either side, in addition to the translucent blue main buttons and clickable scroll wheel on top, so by default the student gets not only the auto-scroll option but Web browser or Windows Explorer "back" (left) and "forward" (right)

buttons. In the ATS unit, the "back" and "forward" buttons will be mapped to "previous question" and "next question", respectively.

The ATS portable mouse includes a Windows driver that lets the student reprogram the buttons - to cut and paste data, minimize and maximize windows, open the Start menu, activate a screen-magnifying zoom window, or other similar functions. Hence the student could re-map some of the mouse buttons to other navigation and playback features if so desired, just like a typical desktop mouse. This is especially beneficial for mobility-impaired users who can replace several difficult precision movements with a single button click.

The device specifications for the portable mouse are as follows:

- Compatibility: USB (PS/2 adapter included)
- Optical mouse for precision control
- Works on any surface without a mouse pad
- Dimensions: 2" x 3.5"

Note that the USB version of the mouse will be used, so that the ATS PS/2 port remains free for a user-selected mouse. Users can also daisy-chain other USB mice and use either mouse for data entry.

Other ATS-compatible Input Devices

The ATS unit will have maximal compatibility with other input devices. The ATS unit will be compatible with any USB or PS/2 keyboard, any USB or PS/2 mouse, or any mini-phone jack microphone (for voice recognition control –ATS Version 2). In addition any standard selection device such as a sip-and-puff control, a switch, or specialized mini-keyboard can be used through either USB, Serial, or Parallel ports.

Every effort will be made during the pilot ATS project to compile and test a list of compatible input devices based on feedback from the test student population and focus group studies.

ATS Output Devices

The ATS devices will have two main options for user output: devices that are shipped with the product, and devices that the student already owns and chooses to use. The following output devices will ship with the ATS unit:

ATS Speaker

The ATS unit will include a built-in speaker with a custom-built amplifier (pictured below) for use in audio playback. The speaker will be sufficient for use under ordinary testing conditions where the student can operate without distributing other test-

takers. The amplifier has been specially developed by gh to provide clear, undistorted sound for typical recorded speech playback at high volumes.

Figure 11: An example of a built-in ATS speaker

The device specifications for the built-in speaker are as follows:

- Samarium Cobalt Low Profile Speaker
- Round frame, Anodized metal surfaces, Ultra thin, Paper diaphragm
- Dimensions: 50mm Dia. x 8.5mm High--2.0" Dia. x 0.3" High
- Input: Nom(W) .3--Max(W).5
- Imp(Ohm): 8
- SPL(dB) 85
- Frequency Range(Hz): 550 to 5000
- Magnet Size: 12.5mm Dia. x 1.5mm High--0.5" Dia. x 0.6" High
- Weight: .03 lbs.

ATS Earphones

The ATS unit will also include portable earphones/headphones (pictured below) for use in audio playback. The earphones are intended to be comfortable enough for long-term use under testing conditions where the student needs to listen to the audio test without distributing other test-takers. The earphones have been tested to provide distortion-free sound quality for typical recorded speech.

Figure 12: An example of portable ATS earphones for audio playback

The device specifications for the ATS earphones are as follows:

- Frequency Response: 80-20,000 Hz
- Lightweight, in-the-ear dual ear bud design
- Includes convenient wind-up spool carrying case for protective storage
- Straight, dual entry 4 foot cord
- Reliable L plug for improved durability
- Stereo or Monaural support

Other ATS-compatible Output Devices

The ATS unit will have maximal compatibility with other output devices. Although it is intended primarily as an auditory method for test delivery, the ATS unit will be compatible with any standard VGA-input monitor, for those students with functional vision. It is intended that later versions of the ATS will include a portable monitor as well to eliminate the need for a separate monitor entirely (see picture below, and refer to ATS Version 2). The ATS will also support output to other video devices as well via an S-video connector (for Closed-Circuit Television input), and an optional RCA adapter for TV input.
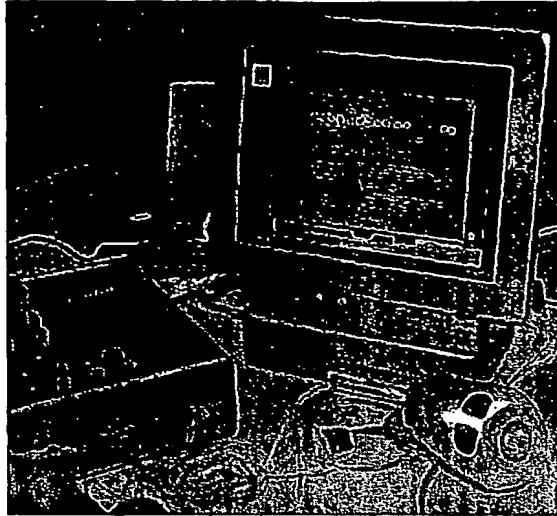
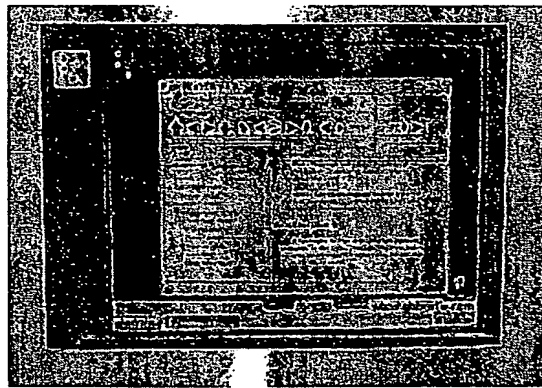**Figure 13: An example of a future portable monitor for the ATS unit**

Figure 14: An close-up of an example future portable monitor for the ATS unit

Via the USB, parallel, and serial ports, the ATS unit can also support third-party Refreshable Braille Displays, Braille Embossers, and ordinary printers. It remains to be determined from the pilot test which of these devices, if any, should be supported natively in future models. At the least, native braille display support (as pictured below) is planned for future ATS models (refer to ATS Version 2).
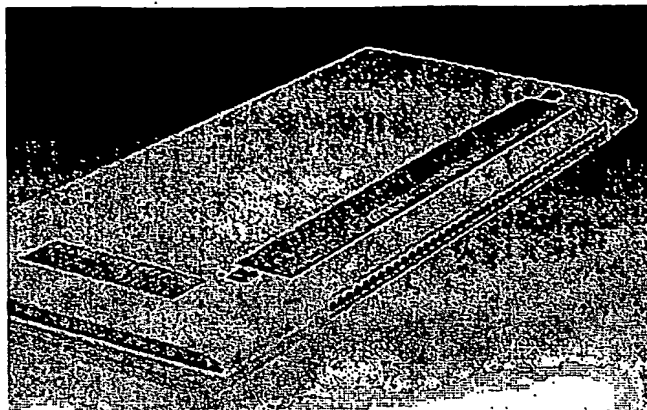
Figure 15: An example of a potential ATS-compatible Refreshable Braille Display device

Every effort will be made during the pilot ATS project to compile and test a list of compatible output devices based on feedback from the test student population and focus group studies.

ATS Software Platform

The core delivery technology for the ATS platform will be based on the gh READ™ line of products. This technology allows for the seamless distribution of fully accessible, easily integrated tests via the ATS station. The core features of the ATS software will be detailed below. A separate discussion of the accessibility features, navigation features, and test content will be given as well.

All of the ATS software will be preloaded and tested on each ATS hardware unit utilized during the pilot study.

ATS Software Core Features

The ATS software is based on the gh READ™ technology, as used in READ™ Files and READ™ forms. Although the ATS software will be a custom-developed application of the READ™ technology, many of the core features remain the same. The major features of the core ATS software can be categorized into three sections: the Media Conversion Process, Synchronized Multimedia, and Semantic Markup.

Media Conversion Process (MCP)

Simply put, The Media Conversion Process (MCP) is how gh makes media accessible. It's a flexible and unique XML-based process that takes a variety of inaccessible print or electronic text formats and produces the desired accessible media - whether electronic Braille, Digital Talking books, or READ™ products, just to name a few. The process begins with ETS sending the test to gh and ends with rich and powerful accessible media as deployed on the ATS removable media storage unit or CD-ROM.

The MCP involves both the creation of the media itself and the features of the playback software.

Synchronized Multimedia

The most important concept of the READ™ technology is the idea of synchronized multimedia. In synchronized multimedia, audio, video, text and images are precisely timed to coincide with each other. For instance, the user can follow the highlighting of each word in a READ™ product while listening to the corresponding audio speech output. The user can even show an image while voicing a descriptive narrative of that image. A user who is deaf may watch an animated interpretation in sign language while following the text captioning. If the user is taking a test that involves foreign language, synchronized multimedia provides the power to display English text with Spanish audio (for example). Synchronized Multimedia is a feature of the gh TOOLBAR™, which is the playback software used for the ATS unit (and all READ™ products).

Semantic Markup

For purposes of testing, the design considerations of the media itself is of equal importance to the playback software used. Semantic Markup is the process that gh uses to author the test media, to ensure that the playback of the information is deployed in the manner desired by ETS. Semantic markup allows additional meaning (via attributes) to be associated with the marked-up test data. For example, sentences can be marked up in Subject/Predicate/Object format for ease in displaying multiple languages in synchronization. Of most concern to the audio testing environment is the use of semantic markup to specify the exact pronunciation of heteronyms and other difficult to pronounce words, such as "wind" and "minute". In addition, special constructs such as acronyms can have one visual appearance and an entirely different audio pronunciation (such as IRAP being pronounced as "eye-rap"). Special scripting of audio tests can be performed as well to organize the test in a specific format. Hence the gh-authored test media is designed from the beginning to play back clearly and precisely on the ATS unit.

READ™ Products

With gh READ™ products, persons with print disabilities can benefit from quick navigation of electronic documents and access to electronic graphics, as well as the ability to easily navigate, complete and submit electronic forms. gh Random Electronic Access Documents (READ) include READ™ Files and READ™ Forms that are developed using the gh XML-based Media Conversion Process (MCP). READ™ products are viewed in the Microsoft Internet Explorer browser and can be generated from a variety of input formats including PDF, TXT, HTML, DOC, and even print pages.

As mentioned, the ATS software is a custom application of the existing gh READ™ technology. READ™ is employed in three major products currently offered by

gh, of which the ATS software is a hybrid: READ™ Files v1.1 and v2.0, and READ™ forms. Each relevant product will be described in further detail below.

Many electronic documents, tests, and World Wide Web pages are not accessible to persons with print-disabilities because either the media content is not authored in an accessible format or the screen reader software used to access these pages lacks the capability to interpret complex visual information such as flowcharts and computer screenshots. Most screen reader users also rely on cumbersome linear navigation techniques that prevent them from productively transitioning from section to section.

READ™ Files v1.1

READ™ Files 1.1 are XML-based electronic documents viewed in an Internet browser that are Section 508-compliant and compatible with screen readers. READ™ Files 1.1 offer persons with print-disabilities quick navigation to electronic documents and access to electronic graphics. These web-based files provide convenient access to a variety of applications including online training manuals and publications.

Quick Navigation

Using READ™ Files 1.1, the speech output from screen reader software helps a person with print disabilities browse the document in an organized fashion and jump directly to any section of the document. The advanced navigation tools provide quick access to desired information.

Access to Electronic Graphics

READ™ Files 1.1 are also useful for accessing electronic graphics and pictures. Verbal Descriptive Narrative (VDN) statements provide clear and logical descriptions of the graphics and their association with the document. Working together, the navigation tools and VDN statements provide effective and quick access to documents and graphics.

A sample of a flowchart converted from an inaccessible picture format (*.GIF) to an accessible READ™ File (xHTML) version is given below:

Figure 16: Example of converting a Flowchart into a READ™ version 1.1 File

READ™ Files v2.0

READ™ Files 2.0 include the added benefits of the gh TOOLBAR™ (pictured below) and offer persons with print-disabilities a more powerful web-based tool for accessing documents such as training manuals and publications. With the addition of the gh TOOLBAR™, users can benefit from a variety of new accessibility features while leveraging the value of previous versions. These XML-based web documents are Section 508-compliant and do not require any external assistive technology. Like their predecessor, READ™ Files 2.0 are developed using the gh Media Conversion Process (MCP) and can be generated from a variety of input formats including PDF, TXT, HTML, DOC, and even print pages.
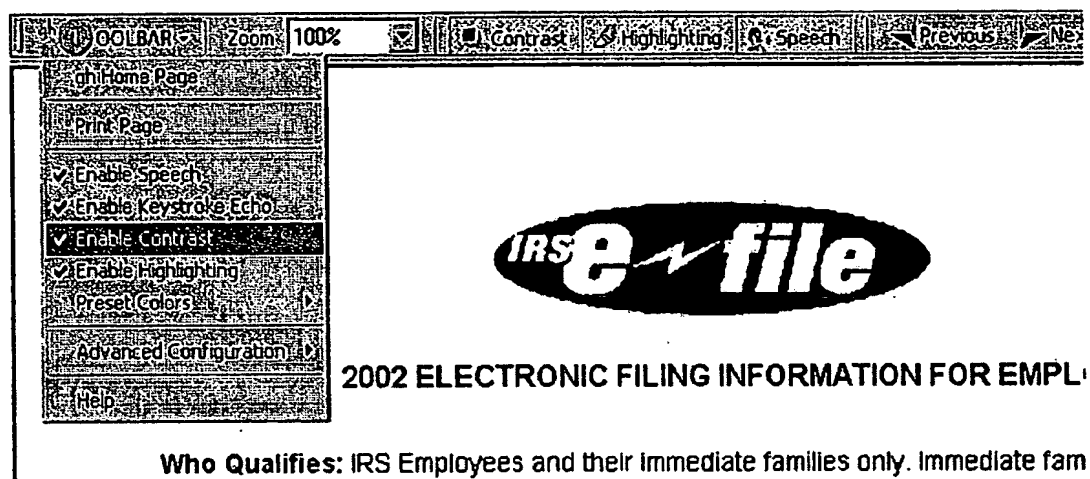
Figure 17: Screenshot of gh TOOLBAR™ features

READ™ Forms v1.0

READ™ Forms 1.0 (see sample below) are Section 508-compliant and enable persons with print disabilities, including those with learning disabilities and mobility impairments, access to electronic forms. These XML-based web documents are a replacement for inaccessible PDF forms, and with the gh TOOLBAR™, users can navigate, complete, and submit READ™ Forms without the use of external assistive technology such as screen reader or screen enlargement software. Like the other READ™ products, READ™ Forms 1.0 are developed using the gh Media Conversion Process (MCP) and can be generated from a variety of input formats including PDF, TXT, HTML, DOC, and even print pages. Like tests, READ™ Forms are an interactive media by nature and are designed to be utilized according to a three-step process encapsulated by the words navigate, complete, and submit.
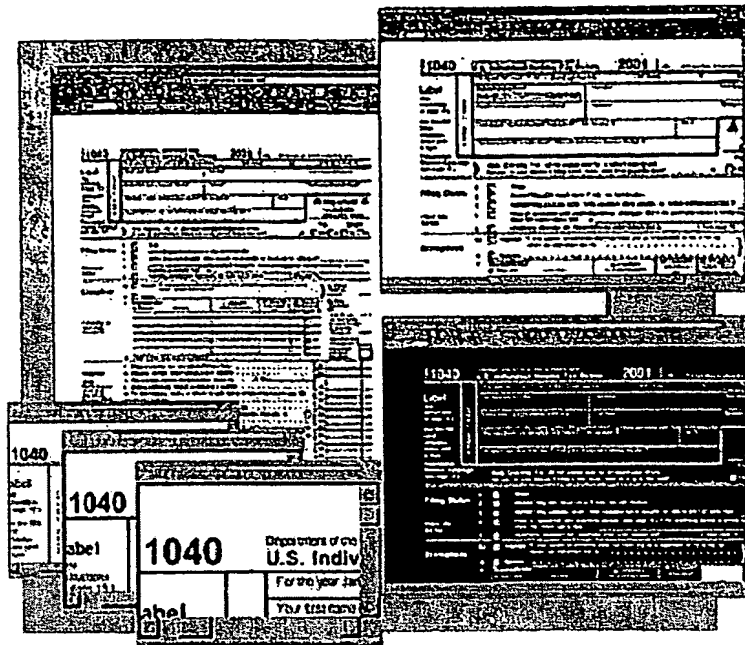
Figure 18: A sample READ™ Form with interactive components

Navigate

READ™ Forms can be posted online and made available to students, employees, and consumers at any time. Users can conveniently navigate READ™ Forms in the Microsoft Internet Explorer browser by pressing the Tab Key on the keyboard. Low vision users can benefit from Text Highlighting to help guide them through the Form. For the ATS implementation, extended navigation features such as those specified in the ATS Core Unit, and again below in the Navigation Features of the ATS Software, will be included.

Complete

READ™ Forms are easy to fill-in and complete whether the user is connected to the Internet or working offline. Directions and cues are voiced to the user through a Text-to-Speech engine and Echo Keys verbally repeat each character as it is typed to confirm the accuracy of the information. READ™ Forms also offer intelligent capabilities by automatically calculating arithmetic functions. Low vision users can customize the contrast settings with the gh TOOLBAR™ by changing the background and foreground colors. They can also enlarge the text up to any size and benefit from a high level of clarity. For the ATS implementation, completion will involve the recording of answers and other data that the student enters, which will be returned to ETS stored in XML format (deployed using an ETS-proprietary Document Type Definition or other Schema to be defined by ETS and gh in conjunction).

Submit

READ™ Forms offer the capability of three easy methods of submission. They can be securely submitted as an email attachment or online and integrated with a database. They can also be printed on standard letter size paper or as Large Print on 11" x 17" tabloid paper. For the ATS version, the standard method of submission will be electronic, using the XML output stored on the removable media, which will be physically shipped to ETS for recording and analysis. If desired by ETS, future versions of the ATS may allow the student to print the results out on a standard ink printer for hard-copy submission as well (refer to ATS Version 2).

Accessibility Features of the ATS Software

As specified, the ATS software will encompass a variety of features designed to enhance the accessibility of the test-taking environment. A partial list of these wide-ranging features is given below. Please note that the features are divided into categories based on disability or user type. The features are then further subdivided into two categories: those planned for the first phase of the ATS project (the initial pilot study), and those planned for later versions (refer to ATS Version 2). Also note that in many cases features listed for one category could be applied to another, and in this case the feature was not listed more than once. For example, speech output is valuable for both Blind and Learning Disabled Students. Many of these features have already been demonstrated to ETS in the "gh Powerprep demo" which can be referred to as needed

Also note that these accessibility features are features of the ATS device (both hardware and software), and not the media itself. There are other, more test-specific features that can be added using semantic markup to the actual test media to augment the user experience. For example, as shown in the sample audio files that accompany the proposal, different voices can be used to provide emphasis or to help keep track of missing information, or pronunciation of heteronyms can be specified, and so forth.

<u>Features for Blind Users</u>

Planned for ATS version 1
- Advanced controls for the synthesized speech engine, including voice selection, rate of speech, and volume control (see figure below)

Figure 19: Example of ATS Speech control features for blind users

- Speech Output of test/media content using Text-To-Speech (TTS)
- Navigation controls self-voiced using speech via TTS
- Keyboard Control of all navigation and playback functions

Planned for future ATS versions
- Customized Keyboard Controls for Braille Input (six key entry)
- Braille Display output (either integral to the hardware device or standalone)
- Support of Braille Embossers and/or Ink Printers for hard-copy
- Special advanced Navigation features for tables

<u>Low-Vision</u>

Planned for ATS version 1
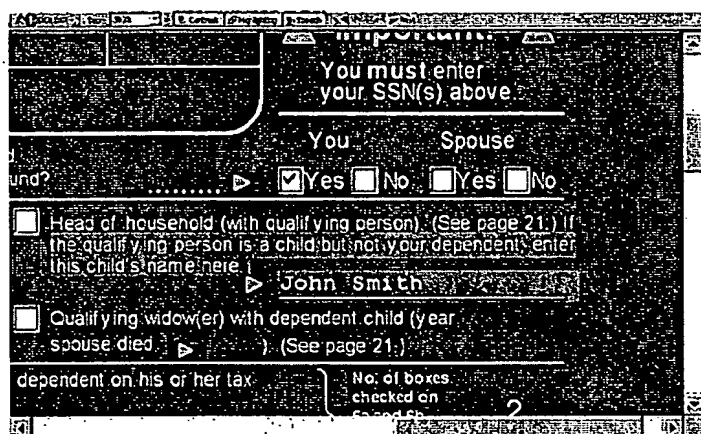- Full enlargement and contrast control of text and graphics display (see picture below)

Figure 20: Sample of using ATS enlargement and contrast control for a Low-Vision user

- Mouse control over view pane and zoom features
- Supports video output to CCTV or other TV device
- Supports VGA out for separate monitor
- Speech output for content and navigation to supplement vision

Planned for future ATS versions
- Some visual/contrast control over user interface (menus and buttons)
- Supports output to standard printer as large print hard-copy
- Global-overview preview pane for absolute and relative positioning

<u>**Upper-Extremity Mobility Impairment**</u>

Planned for ATS version 1
- Support of alternative pointing devices such as head pointers in lieu of mouse – for specific listed devices
- Some user-definable keyboard mapping (user can redefine the keystrokes for navigation and playback features)

Planned for future ATS versions

- Voice Recognition (using Advanced Voice Recognition or AVR) for Navigation
- Voice Recognition (using AVR) for dictation and content entry
- Integrated On-screen virtual keyboard with word prediction

Severe Mobility Impairment affecting head positioning or speech

Planned for ATS version 1

- Support of alternative keyboards such as switches and sip-and-puff – for specific listed devices
- Voice output to supplement visual display

Planned for future ATS versions

- Virtual-Reality display device for head-mounted use

Learning Disability (specific to reading)

Planned for ATS version 1

- Highlighting function at any granularity for reading comprehension (i. e. by word, by sentence, by paragraph – see example below)

Figure 21: Example of using the ATS highlighting feature for a Learning Disabled user

- Adjustable reading rate control
- Spelling Function for unfamiliar words (word is spelled out rather than read)
- Repeat Function at varying granularity (e. g. repeat the last word or last sentence)
- Style Sheet control for coloring and font adjustment to cue reader about format – limited settings that may be overridden by high contrast mode (e. g. turn all headings blue, turn all answers red, and so forth)
- Advanced navigational cues such as the "Where Am I?" feature – for defined terms (e. g. "What Question am I on?", "What Page am I on?", What Section am I in?" and so forth)
- Synchronization of multiple media streams for multimodal input
- Icon-based representations of navigational controls (e. g. left-right arrows for previous or next question, respectively)

Planned for future ATS versions
- Dictionary function for unfamiliar words – for specific environments where this is sanctioned by ETS (i. e. when reading instructions for example)

Deaf

Planned for ATS version 1
- Text or American Sign Language (ASL) Captioning of all auditory parts of media

Planned for future ATS versions
- Concatenated Video-based ASL output in synchronization with other media
- Virtual 3-D Avatar-based ASL output in synchronization with other media (see example below)
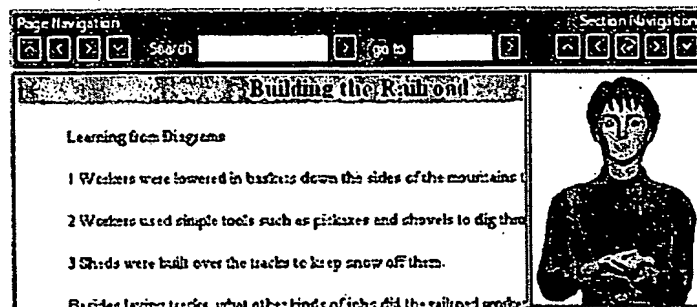

Figure 22: Example of a computer-generated sign language avatar for captioning text

- English-syntax ASL video playback in conjunction with speech

Hard-of-Hearing

Planned for ATS version 1
- Third-Party Support for Direct input to hearing aid or cochlear implant for improved speech recognition

Planned for future ATS versions
- Integrated Direct input to hearing aid or cochlear implant
- English-syntax ASL mode for improving text literacy

Cognitive Disability (other than already discussed in LD)

Planned for ATS version 1

- Improved reading comprehension from multimodal stimulus and highlighting

- Consistent formatting (adjustable via style sheet) to cue reader about the division of document styles (for example, headings or thesis sentences are visually emphasized with colors)
- Auditory and other cues to aid in reading (i. e. sound effects and animation) – for listed features

Planned for future ATS versions
- None currently

<u>**Augmentative and Alternative Communication User**</u>

Planned for ATS version 1
- Icon-based system for user input (such as answers or demographic data)

Planned for future ATS versions
- Virtual Icon-based communication system that generates speech (via TTS) for interactive communication (with test proctor, for example)
- Customizable keyboard (with icon displays) for input
- Third-Party Compatibility with VOCA devices

<u>**General Literacy (other than already discussed in LD)**</u>

Planned for ATS version 1
- None currently

Planned for future ATS versions
- Thesaurus mode for assistance in input/writing
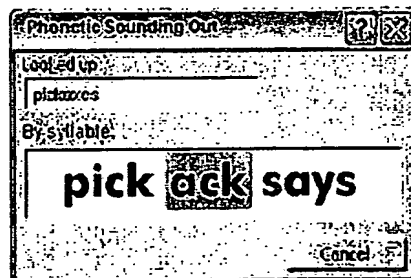- Phonetic "sounding out" using TTS engine and highlighting (see example below)

Figure 23: Example of using phonetic "sounding out" as an aid for general literacy

<u>**English as a Second Language (ESL) and other Language concerns**</u>

Planned for ATS version 1
- Spanish version of instructions available
- Spanish version of navigation controls available

Planned for future ATS versions

- Foreign Language learning mode for English speakers who are learning a new language – for example, having the instructions in Spanish
- ESL mode (foreign speech with English text) for teaching English to ESL users
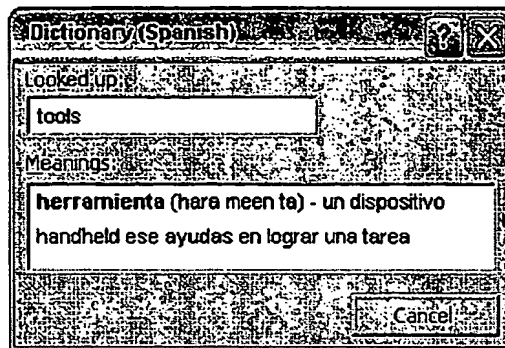- On-line dictionary for foreign words (see example below)

Figure 24: Example of a Spanish-English dictionary for ESL support

- Color coding, sound cues, and other multimedia cues for foreign words in English text
- Multiple Language support for test, instructions, and navigation controls

Navigation Features of the ATS Software

The basic navigation features for the ATS Software will be very similar to those previously demonstrated to ETS in the "gh Powerprep demo" which can be referred to as needed. These navigation features can be divided into three categories: basic navigation, test tools, and user interface features, each of which is described in more detail below.

Basic Navigation Features

The basic navigation features for the ATS software are summarized in the table below.

Basic Navigation Functions
Jump to Previous Question
Jump to Next Question
Jump To Previous Section
Jump to Next Section
Page Up
Page Down
Play and Pause Audio
Advance Audio Back 5 Seconds
Advance Audio Forward 5 Seconds

Return to Beginning of Test
Go To Page
Text Search/Find (by keyword)

All navigation features will be accessible using either the mouse or keyboard. Keyboard shortcuts will be user-definable, and listed in the help file for the ATS software and in a quick-reference guide. An example of the graphical representation of the navigation tools is given below.

Figure 25: Example of a typical navigation skin for the ATS software

3. STUDY:LEARN::

  ○ (A) pervade:encompass
  ○ (B) search:find
  ○ (C) gather:win
  ○ (D) agree:keep
  ○ (E) accumulate:raise

Figure 26: Typical Answer Choices (as radio buttons) for ATS Software

Test Tools

The basic testing tool features for the ATS software are summarized in the table below. Examples of some of the features are given as screenshots below.

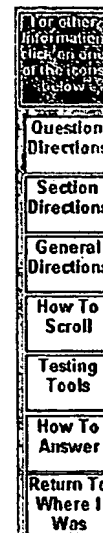| Testing Tools |
|---|
| Quit Test |
| Section Exit |
| Toggle Time Display ON/OFF |
| Next Question |
| Confirm Answer |
| Open Help Menu |
| Question Directions |
| Section Directions |
| General Directions |
| How to Scroll |
| Testing Tools |
| How to Answer |
| Return to Where I Was |

Figure 27: Example of the Help Menu from the ATS Software

All test tool features will be accessible using either the mouse or keyboard. Keyboard shortcuts will be user-definable, and listed in the help file for the ATS software and in a quick-reference guide. An example of the graphical representation of the basic testing tools is given below.

Figure 28: Example of the basic test tools from the ATS software

User Interface Features

The User Interface features for the ATS software are summarized in the table below.

User Interface Controls
Enable/Disable Speech
Enable/Disable Contrast Controls
Enable/Disable Highlighting
Enable/Disable Keystroke Echo
Digital Zoom (by percent)
Set Background Color (palette box)
Set Text Color (palette box)
Set Highlight Color (palette box)
Keyboard Shortcut Settings (dialog box)
Preset Style Sheets Selection Control
Volume Control
Rate of Speech Control
Voice Selection Control (by name of speaker)

All user interface features will be accessible using either the mouse or keyboard. Keyboard shortcuts will be user-definable, and listed in the help file for the ATS software and in a quick-reference guide. An sample screenshot is also shown below.
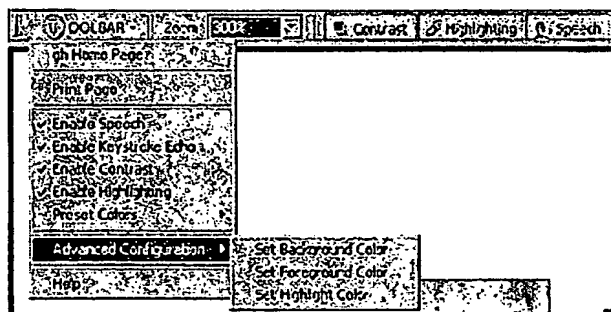

Figure 29: Example of the User Interface features for the ATS software

Content of Tests

The actual content of the tests used in the pilot study will be determined by ETS. Using the MCP technology discussed earlier, gh will then author the accessible version of the test and deploy the tests themselves on the removable media (refer to Removable Media for ATS Test Storage). A total of 10 (ten) copies of the test will be distributed on the removable media, distributed according to the table below:

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# tests	Location
2	In-house development stations for gh
1	On-site ETS unit (Princeton office)
3	Proctor Site #1 (Purdue)
2	Proctor Site #2 (New Jersey)
2	Proctor Site #3 (California)
10	TOTAL TESTS FOR PILOT

Demographic, test, and answer data will be stored on the removable media **only**, for data collection and analysis. Each removable media device will contain the following information:

Data contained on Removable Media Device
READ™ version of the test (XML)
Student demographic data and test answers (XML)
Pre-recorded audio version of test (MP3)

Since the actual test is to be used for a pilot study, and not a full rollout version, ETS and gh will mutually determine the type and amount of material to be converted to accessible format. It is expected that this material will amount to a portion of an actual GRE practice test as opposed to the entire version. This will have the added benefit of reducing the time commitment of the volunteer student test subjects.

ATS "soft" technology

Soft technology is defined as the documentation, training, and other services that in conjunction with the hard technology provides the necessary intervention for the special needs student. In this case, the soft technology is composed of a three major components: Documentation, Installation and Setup, and Training. Each is described in more detail below.

Documentation

The ATS documentation will consist of three major parts. The first part will be a standard Windows Help File (*.CHM) which can be accessed at any time from inside the ATS software program itself. The second part is an external quick-reference guide meant to be utilized as a supplement to the actual program itself, either electronically or as a standalone hard-copy reference. The third part involves a tutorial, designed for both proctor and student, that demonstrates how the equipment is meant to be used and walks the user through a short sample test. All three types of documentation will be available in accessible format as discussed in more detail below.

Standard Help File

The ATS software will come bundled with a standard Windows Help File compiled in *.CHM format (see illustration below). This file will contain complete documentation about the various parts of the ATS software, including user features, control commands, troubleshooting, and so forth. It will be available to the student at any time by using the ALT+F1 keystroke or by selecting "Help" from the main menu.

The Standard Help file will also be compiled in a slightly different XML version, which will be available by using the ATS software itself to open it (just like any other media such as a test or instructions). This version will be the accessible version of the standard help file. No hard-copy accessible versions of the Standard Help File are planned.
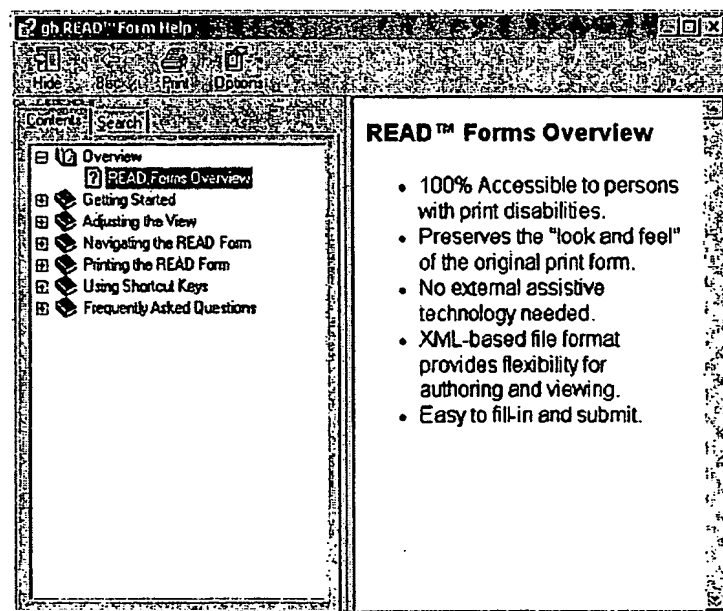

Figure 30: Standard Windows Help File for the gh READ™ Form

Quick-Reference Guide

The ATS software will also come bundled with a Quick-Reference Guide compiled in XML format (see illustration below). This file will contain basic information about the control commands and key features of the ATS software. It will be available to the student at any time by opening the file in the ATS software itself, which can be done using either the mouse or the keyboard.
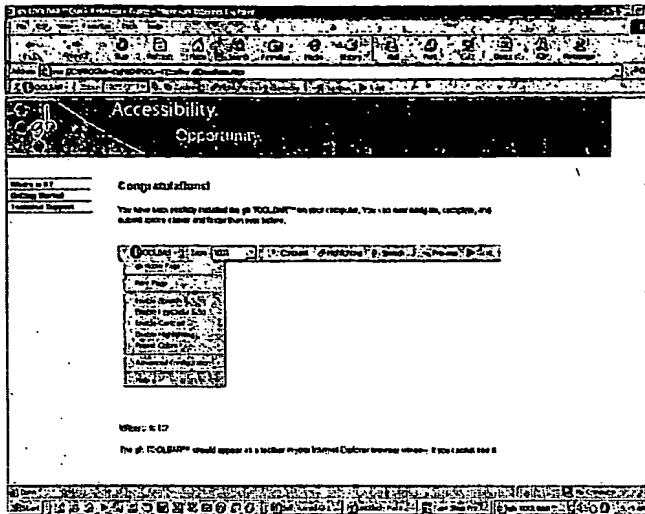
Figure 31: Quick Reference Guide for the gh TOOLBAR™

A central feature of the Quick-Reference guide is the list of default control keys (pictured below). Although the control keys of the ATS can be remapped according to the user's input, and even saved as a separate user profile, this is a vital feature for the beginning user. As illustrated, the list of important keystrokes is short enough that it can be memorized in one sitting.
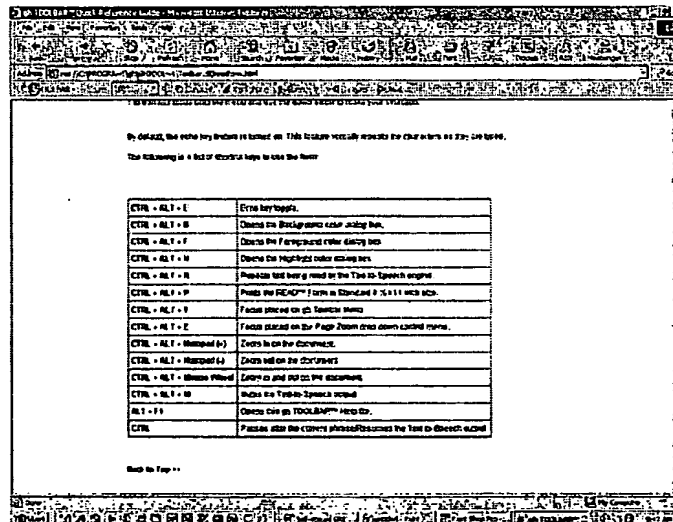

Figure 32: Default Keystroke List (located in the gh TOOLBAR™ Quick Reference Guide)

Because of the importance of the ATS Quick Reference Guide to the users, several hard-copy accessible versions will be developed. gh will provide a total of 10 (ten) copies of the Braille, Large Print, and recorded audio (on CR-ROM) versions of the Quick Reference Guide. The Braille version will include a tactile graphic screenshot of the ATS software to help familiarize the user with the program interface. The recorded

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audio version will be rendered using the same high-quality synthesized speech used in the ATS unit itself, hence allowing the student an extra method of becoming comfortable with the speech engine prior to using it for purposes of taking an actual test.

Tutorial

One of the most important parts of the ATS station will be the tutorial disks. The tutorial will be composed of two separate sections delivered on a single multi-session CD-ROM (see table below). One section is meant for test proctors, and the other for the students themselves. Each will have different features as described below, but both will consist of a multimedia presentation of the relevant information.

Data contained on ATSsoft technology CR-ROM
Analog Audio Version of Quick-Reference Guide (audio)
Digital Audio Version of Quick-Reference Guide (MP3)
Braille Version of Quick-Reference Guide (BRF)
Standard Quick-Reference Guide (XML)
Standard Help File (CHM)
Proctor Tutorial (Flash)
Student Tutorial (XML)
Analog Audio Student Tutorial (audio)
Digital Audio Student Tutorial (MP3)
Braille Student Tutorial (BRF)

Proctor Tutorial

The primary purpose of the Proctor Tutorial is to help a non-disabled test proctor become comfortable with both the ATS unit and the kinds of problems or questions that could arise during testing. This tutorial will be compiled as a self-executing Macromedia Flash file (meaning that Flash is not required in order to run the tutorial). As such, it can be viewed on any computer including the ATS unit itself. The proctor will work through this short (30 minute) tutorial before actually using the ATS unit in a testing environment.

Items to be addressed in the Proctor Tutorial include:

- Setup of the ATS unit
- Maintenance of the ATS unit
- Troubleshooting of the ATS hardware
- Common Questions that may arise during testing about the ATS software interface
- A brief, mock examination session with a few scripted user-related problems to solve

Student Tutorial

The primary purpose of the Student Tutorial is to help a disabled test taker become comfortable with both the ATS unit and the format and user interface of the software. This tutorial will be compiled as a series of linked XML files (meaning that only Internet Explorer is required in order to run the tutorial). As such, it can be viewed on any computer including the ATS unit itself. The student will work through this short (30 minute) tutorial before actually using the ATS unit in a testing environment.

Items to be addressed in the Student Tutorial include:

- Using the ATS hardware
- ATS hardware adjustment features (e. g. volume control, keypad buttons)
- ATS software layout and function
- ATS software user interface controls
- Pre-scripted settings for various disability types (e. g. low-vision, learning disabled)
- A brief, mock examination session with a few scripted questions to answer

In addition to the software XML version of the Student Tutorial, several accessible versions will be developed as well for those students who are less comfortable to "diving in" to computer usage. These versions will include an audio-only narrative version (meant for use with any audio CD player) and an MP3 audio version. A Braille file of the narrative will be provided as well for use on a refreshable braille display.

Additional Features

Of the features currently being planned for later versions of the ATS unit, several bear specific mention:

- Printing out a hard copy – it is currently possible with the READ™ technology to print hard-copy forms and answer sheets that are indistinguishable from the original print versions. Hence it would be possible, for example, for disabled students to generate a print answer sheet at the end of the exam for those places where tests are still graded manually.
- Voice Recognition – With the addition of an inexpensive ($100) circuit the ATS unit can support voice recognition of up to 60 different navigational phrases. This would allow the student to take and navigate the test using voice, and to fill in answers using voice. In addition, for tests that require dictation, the ATS could utilize full-fledged voice recognition for data entry at a minor incremental cost.
- Refreshable Braille Displays – It is possible to incorporate a small refreshable braille display into the actual ATS unit itself, which would allow the student to read a Braille version of the test instead of listening to the voiced version. This is a superior method of access for Braille-reading students, but could significantly increase the cost of the ATS unit and hence may be an option only for a limited pool of students.

Larger Roll-out Plans

Although it is the intention of the pilot study to address many of the more global issues surrounding a larger roll-out of the ATS unit, two specific issues bear mention in this proposal, as discussed below.

High-Level Specifications for GRE Voiced Pilot

The test is to be voiced and, if possible, linked to refreshable Braille displays. The content will be adapted from existing practice material. Although the operational test consists of two writing tasks, two verbal sections, and two quantitative sections, the pilot will use only one writing task, one verbal section, and one quantitative section. In addition, certain navigation features and data collection required for the operational test are omitted from the pilot and are not detailed in this document.

For certain item-types (primarily Quantitative items with graphs and/or tables, and reading comprehension items with references to specific places in the passage), it will be necessary to consult with a designated content with regard to how much information is to be given to the examinee. These decisions are typically made on an item-by-item basis, although some general principles apply.

Testing Tools

Examinees should have access to the following within each section of the test:

- Exit Section tool (with confirm)
- Quit Test Tool (with confirm)
- Time-tool (indicate how much time is remaining). If feasible without undue delay or cost, warn examinee when there are 5 minutes of time remaining in section.
- General help on how to use the system (i.e. how to navigate, how to respond to questions, how to type in an essay, cut, paste, etc.)
- Test-level and section-level directions (see below)
- Where relevant, item-type and set directions (see below)

Within the verbal and quantitative sections only:

- Next/previous tool or command (except when at the very end or very beginning, respectively).
- Review Tool or command (see below under "Navigation and Timing")
- Each response to a test question must be confirmed before being recorded.
- When an item is voiced, the item number and total number of items in the section, e.g. "Question 3 of 30," should also be voiced. When a stimulus for a set of items is voiced, it should be preceded by the numbers of the covered questions, e.g. "Questions 10 to 12 are based on the following passage [chart/figure]"

Within the writing section only:

- Simple editing tools, e.g. cut, copy, paste. No spell/grammar checker; no formatting (bold, italics, underline). Text of response to be saved as plain text.

Directions

There are 4 levels of directions and/or stimulus material. The bracketed numbers indicate the scope of the material from widest to narrowest scope, and are referenced under "Test Structure and Sequence" below.

[1] General Directions
Must be voiced at the beginning of the test and available at any time between [Start Test] and [End Test].

[2] Section Directions
Must be available while in the relevant section and voiced at the beginning of the section.

[3] Item-type Directions (where relevant)
Must be voiced at the beginning of a group of items of the same item-type and available while working on items of that item type. Some item types may have short-form directions to be voiced at the beginning of each relevant item.

[4] Set Directions and/or Stimulus Material (where relevant)
Must be voiced at the beginning of the set and available while working on the items within the set.

Navigation and Timing

Timing is per section. It begins when the section directions are presented and ends when the section time expires or the examinee exits the section, whichever occurs first. Examinees are permitted to move forward and backward within a section by means of a next/previous tool or command, and also have access to a review tool that lists which questions they have answered and which they have not answered. The review tool also enables the examinee to move directly to any question within the section. Once the examinee leaves a given section, the examinee is not allowed to return to that section. Examinees can exit the section or quit the test at any point of their choosing before time runs out.

Data to be Collected

Data should be returned in XML.

Data are to be written to disk when entered, so that state can be maintained in the event of a crash or power-failure.

The following data are required:

- For each session
    o Session ID
    o Examinee id
- For each item:
    o Section Number
    o Item Number
    o Item ID
    o Response
    o Time elapsed while item is active

If the examinee returns to an item after responding to it, whether through a next/previous command or through the review tool, the **most recently-confirmed response** to that item should be displayed. If the examinee changes the response to a given item, the previously-entered response should be replaced with the most recently-entered response. If feasible without undue cost or delay for pilot, add time spent in item when an item is returned to via next/previous/review to the item record. (Note that in an operational setting, we need to record each event, including keystrokes, mouse-clicks, and include time-stamps; however we have decided to simplify data-recording for the pilot).

For the writing task: store section number, item ID and text of examinee's response. If feasible for the pilot, response-text should be saved frequently so that it can be recovered in the event of a crash. Robust crash-recovery will be required for operational use.

GRE Test Structure and Sequence

[Start Session]

Examinee Login and ID-collection

[Start Test] [1]
Introduction and General Directions[1]

[Start Section] [2]: Writing: Issue Task. Time: 90 minutes (assuming double time; standard timing is 45 minutes)

Display Writing: Issue Task directions[2]

Display two Issue Prompts, and capture item id of examinee's choice of prompt, plus examinee's written response. Examinee's selected prompt [4] must be available to examinee while working on the response.
[End Section] [2]

Ten-minute break

[Start Section] [2] Verbal Section 1. Time 60 minutes
Display section Directions [2]

[Item Type]: Sentence Completion [3]
Display Sentence Completion directions [3]
Present and collect responses, item id, and timing for items 1 - 7
[End Item Type]

[Item Type]: Analogy[3]
Display Analogy directions [3]
Present and collect responses, item id, and timing for items 8 - 16
[End Item Type]

{Item type]: Reading Comprehension [3] (items 17-27, in two sets)
Display reading comprehension directions [3]
[Set]
Display first reading comprehension stimulus [4]
Display and collect response, item id, and timing for associated items
[end set]
[Set]
Display second reading comprehension stimulus [4]
Display and collect response, item id, and timing for associated items
[end set]
[end item type]

[Item Type]: Antonym[3]
Display Antonym directions [3]
Present and collect responses, item id, and timing for items 28 - 38
[End Item Type]
[End Section]

One-Minute Break

[Start Section] [2] Quantitative Section 3. Time 60 minutes
Display section Directions [2]

[Item Type]: Quantitative Comparison [3]
Display Quantitative Comparison Directions [3]
Present and collect responses, item id, and timing for items 1 - 15
[End Item Type]

[Item Type]: 5-choice [3]
Display 5-choice directions [3]
Present and collect responses, item id, and timing for items 16-20
    [set]
    Display Data-Interpretation Set Directions and Stimulus [4]
        Present and collect responses, item id, and timing for items 21-25
    [end set]
Present and collect responses, item id, and timing for items 26-30

[End Item Type]

[End Section]

[End Test]

[Start Scoring]
Determine Scores:

For the verbal and quantitative sections, examinee's responses are compared with the test key (indexed by item id and section number). The total number of correct verbal items is matched with a lookup table which yields the verbal score. Similarly, the total number of correct quantitative items is matched with a lookup table which yields the quantitative Score. The writing tasks are not scored online.

Display scores.

[End Scoring]

[End Session]

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